

July 30, 2004

**North American Monsoon Experiment (NAME) R/V Altair
Leg 1 Cruise Report, July 7 through July 21, 2004**

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The R/V Altair left Mazatlan on the evening of July 6 (julian day 188), arriving at 23.5 N, 108 W, midday (LT) on July 7. Sonde and CTD measurements began at July 7 00 UTC, while flux, ceilometer, and 915 MHz wind profiler measurements began soon after leaving port. We collected data until July 22, 00UTC at station, and launched two more sondes on the transit back to Mazatlan, at 4 and 8 UTC. We also regularly photographed the sky. This writeup provides plots of some of the data gathered at the Altair during Leg 1.

Conditions from July 7-12 were generally clear (with some high-level cirrus) and dry, with calm seas and light winds. Moist convection was visible to our east (including nightly lightning), encouraging a westward mid-level flow over the Altair. Radiative subsidence can be seen in the time series of the soundings. The July 11 east convective activity was particularly noticeable, generating enough cirrus to visibly reach west of the boat. Sounding temperature and relative humidities typically show inversions at both the boundary layer top (up to ~400-500 m) and at ~2km, similar to a trade-wind level inversion (or perhaps corresponding to the height of the land boundary layer ?). The temperature measured by the sea snake (depth ~ 5 cm) climbed from 29.5 C to almost 31 C by July 12.

Tropical Depression Blas moved to the south and southwest of the Altair from July 12 – July 15. The surface pressure at the Altair increased, winds became stronger and more southerly. The most significant precipitation of Leg 1 occurred at approximately 12UTC July 12. What appeared to be a gust front reached the boat that evening (see foto). Clouds at all levels prevailed. Precipitation from higher clouds was common but reached the surface infrequently, as seen in the ceilometer backscattered intensities. The sea possessed long swells and approximately 10-ft waves. The ocean mixed layer warmed and freshened, attaining its maximum values for leg 1.

After the second IOP, conditions at the Altair became quiescent though never as calm as before IOP #2. Mid-level clouds were common, boundary-layer cloud fraction non-zero but low. Near-surface winds were calm and generally from the south until late on July 19, then came from the north. A bimodal distribution in cloudiness and relative humidity below 3 km reappeared again, with a surface-based mixed layer (hypothesized) and a higher moist/cloud layer at about 2 km. The virtual air temperature cooled to 28 C, while the temperature measured by the sea snake remained at about 30 C. After July 19, some light precipitation aloft was evident in the ceilometer imagery, and convection was sometimes visible elsewhere. Total accumulated precipitation during Leg 1 is estimated to be less than 2 mm. When it did reach the deck, it was composed of a few light interspersed drops.

Soundings: .

During IOP periods (July 12, 13, 14, 20, and 21) we launched 6 sondes per day rather than 4.

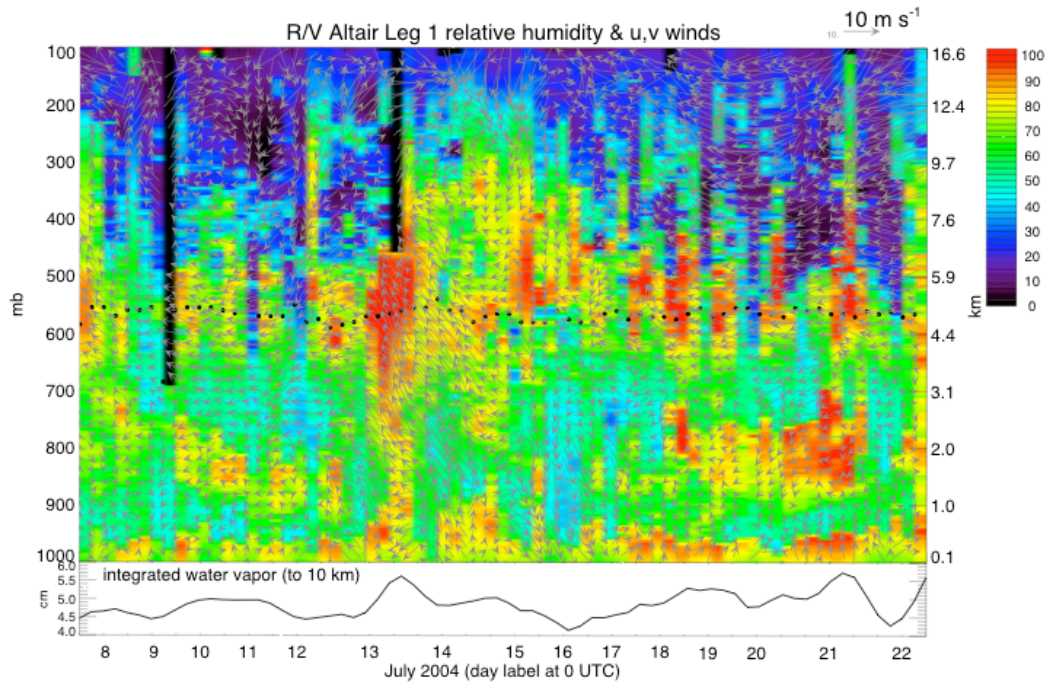


Figure 1: Sonde relative humidities overlain with zonal and meridional winds. Wind vectors pointing up indicate northward motion, pointing to the right indicate eastward motion, etc. The 0-degree Celsius isotherm is indicated by small filled black circles. The bottom panel indicates the integrated water vapor content, up to 10 km.

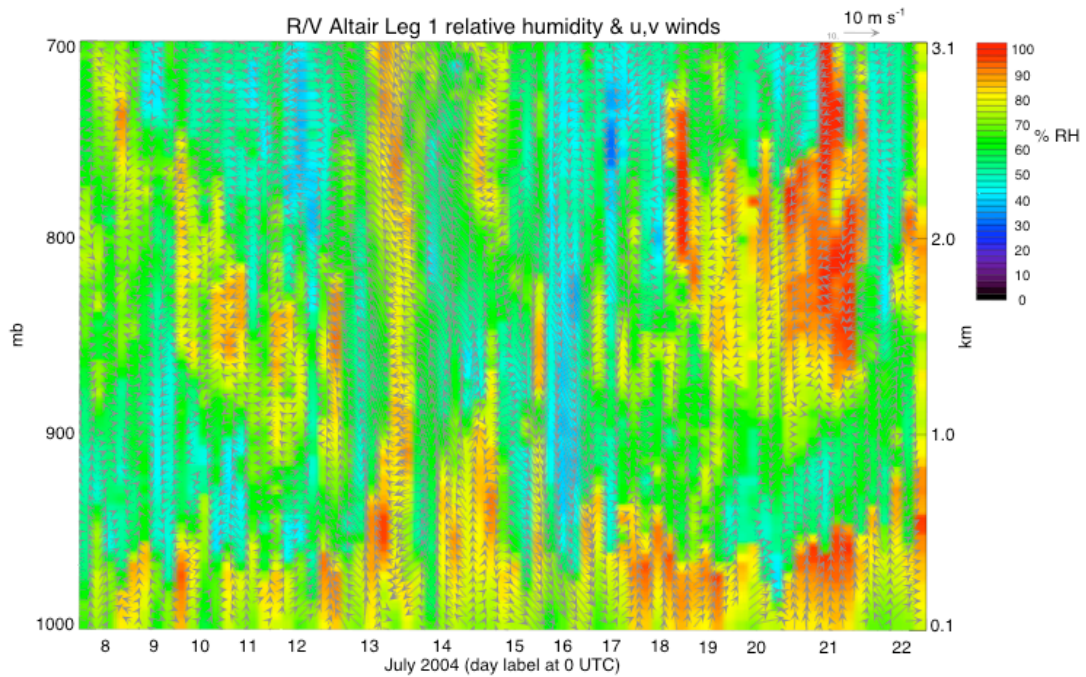


Figure 2: Similar to Fig. 1 but focused on the 1000-700 mb layer, with more detailed winds.

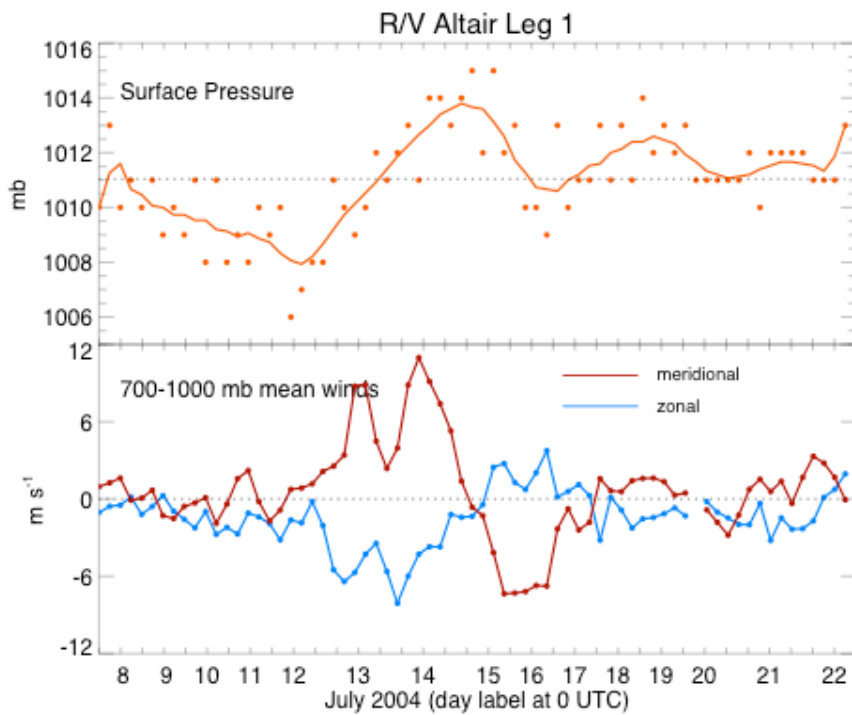


Figure 3: Surface pressure and mean 1000-700 zonal and meridional winds at times of the sonde launches (top and bottom panel). Plotted surface pressure line has been smoothed.

915 MHz Wind Profiler: Greater time resolution of the winds is available from the wind profiler data, an example of which follows.

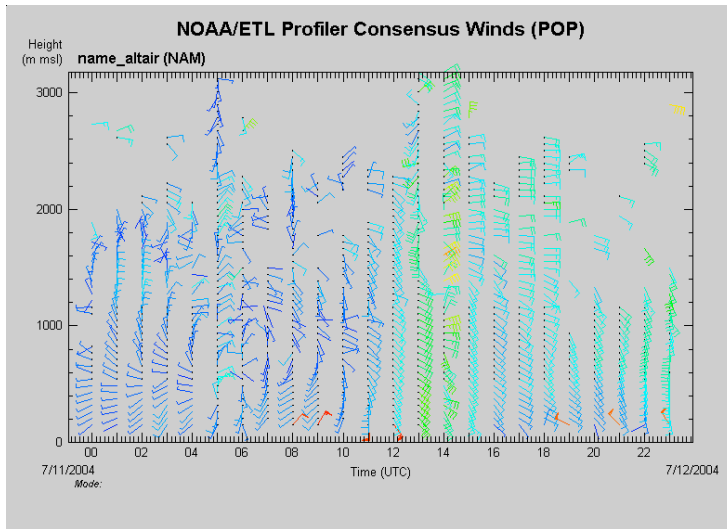


Figure 4: 915 MHz profiler hourly-mean winds for July 12 (disregard time label inside figure). Note that the profiler requires backscatter off of particulate matter to be able to calculate winds (thus more wind data in precipitating conditions). This plot shows winds at 110 m resolution, a vertical resolution of 60 m is also available.

Ceilometer measurements: A vertically-pointing lidar ceilometer recorded the backscattered intensities, and operationally-derived cloud base heights (accuracy of about 30 m) every 15 sec. Its visibility range extended to approximately 7.5 km in clear conditions.

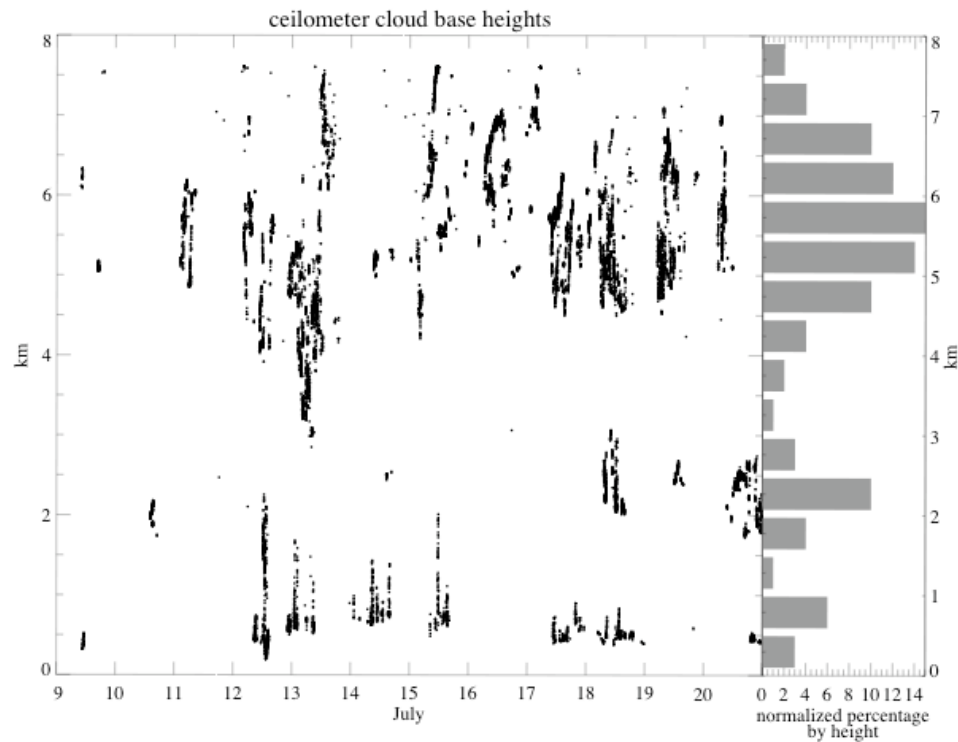


Figure 5: Time series and frequency distribution by height of ceilometer cloud base heights.

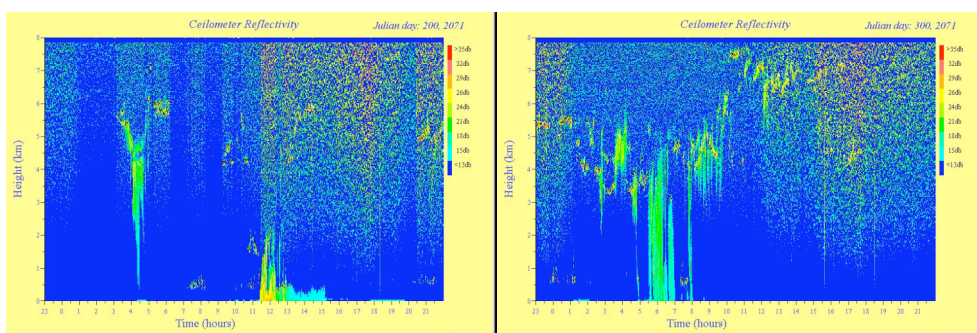


Figure 6: Ceilometer backscattered intensities for July 12 and 13. The vertically-pointing ceilometer attenuates completely when the laser encounters a cloud base, but attenuates more slowly in precipitation, thus serving to indicate regions of below-cloud precipitation. Speckling centered around 18UTC (solar noon) is caused by interference from the direct solar beam.

Sea State Conductivity-Temperature-Depth (CTD) measurements:

CTDs were done 4X per day, at 0, 6, 12, and 18 UTC, to a depth of 150 m.

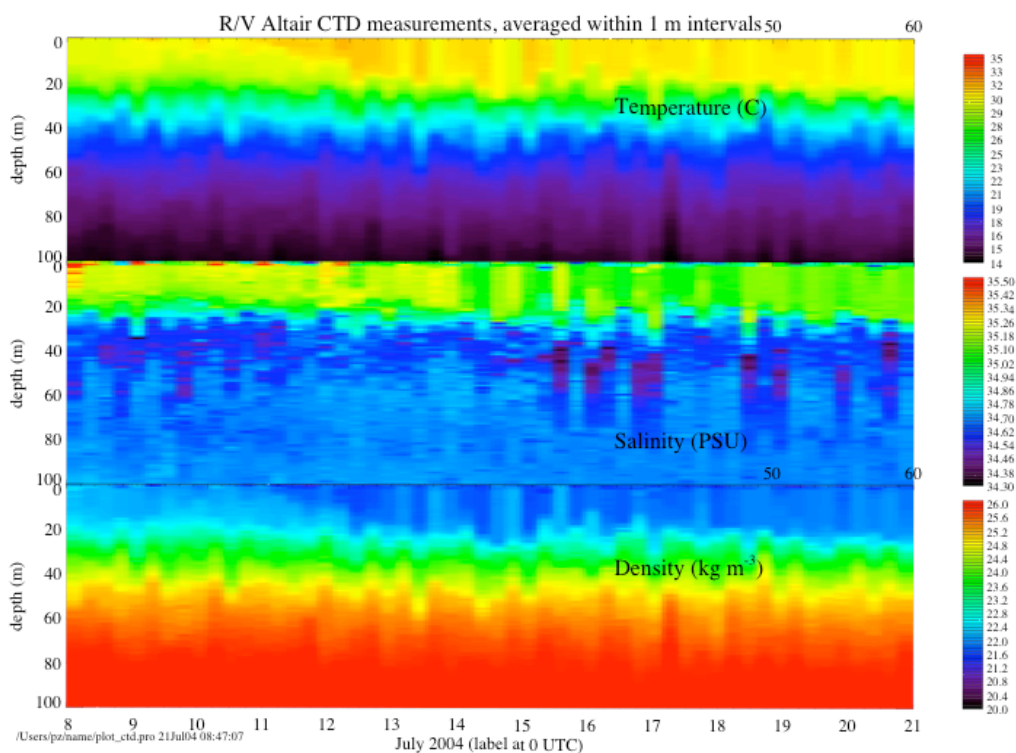


Figure 7: Temperature, salinity, and density of top 100 m of ocean.

Flux Instrumentation Measurements:

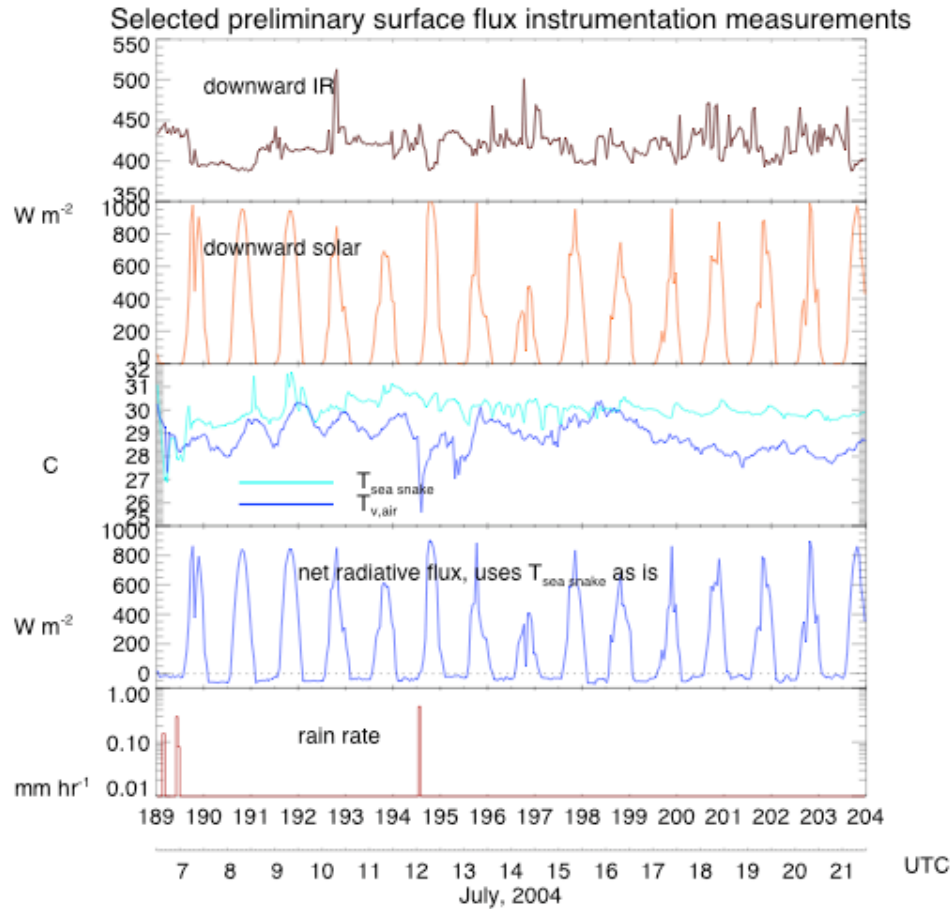


Figure 8: Hourly-mean downward infrared and solar fluxes , the sea snake temperature and virtual air temperature, net radiative flux at the surface, and optical rain gauge rain rate. The sea snake was not placed in the water until midday on July 7. Small, short-lived rain events do not show up on this plot.

Cloud Fotos:

We photographed the sky towards the north, east, south, and west of the Altair 4 to 6 times a day. Fotos are labeled MMDDHHMM_{N,E,S,W}.jpg



July 7, 6 AM LT



Figure 9: July 8, 3 PM (top) 8PM (bottom) LT, looking east

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Figure 10: July 9, 7 AM LT (top) and 6 PM LT (bottom), looking east



Figure 11: July 10, 8 PM LT, looking N,E,S,W respectively



Figure 12: July 11, 4PM LT, looking east to a developing thunderhead in otherwise clear conditions.



Figure 13: July 12, 7 PM LT, looking SW



Figure 14: July 12, 8 PM LT, to the west - south –west



Figure 15: July 13, 7PM LT, looking W



Figure 16: Convective line to N of boat, July 15, local noon



Figure 17: An example of the prevalent mid-level cloudiness, from July 16, 7 AM LT.

APPENDIX: Notes on data attributes and oddities.

Sondes: Initialization values for the soundings are typically provided by a ship's meteorological system. The Altair lacked one, and instead we relied on pressure, relative humidity, and temperature values from flux instruments located on a tower at the bow of the boat. The instrument-recorded pressure was increased by 1 mb to account for the 10 m differential of the instrument from the boat deck. This compared to within 0.1 mb with readings taken from the sonde at the launch location. The early sonde measurements of temperature are often slightly higher than that measured at the tower, presumably a consequence of solar absorption by the boat and heat dissipation of the ship engines. We merely make note of this. Surface wind speeds were initialized, ad hoc, to 5 m/s with a wind direction of 0 degrees.

All sondes were of type RS80-15g, with A-Humicap humidity sensors. The sonde released on July 9, 6 UTC appeared to have a poor pressure gauge, showing a jump in pressure from 693 mb to ~300 mb in 2 sec. Its data between the surface and 700 mb seem reasonable in the plot shown in Fig. 1.

Fluxes: Birds, especially yellow-footed boobies, were abundant. They demonstrated a liking for the ship's crow nest where the infrared and solar radiometers were located. One cleaning done on July 11 found both radiometers dirty and may contribute to a lowered downward solar flux for that day. A cleaning on July 14 found the solar dome relatively clean and the IR dome not – it was later noticed that birds stand on the IR radiometer but not the solar dome, probably because the IR dome is smaller and the platform is more tractable for them. A later cleaning on July 20 found the crows nest completely white from bird feces, but both radiometers were clean (!).



Figure 18: Yellow-footed booby on infrared radiometer.

The sea snake was placed in the water on July 7, mid-morning. Spikes are apparent in the sea snake temperature at times thereafter, which we thought was caused by the current pushing the sea snake against the boat when the boat was still. We shortened the length of the sea snake after noticing this, approximately mid-day on July 10.

25K Vaisala Ceilometer: Speckling is apparent in the ceilometer backscattered intensities. It results from direct solar beam interference and is most pronounced around solar noon, approximately 18 UTC. Also remember the ceilometer will not pick up cloud bases above 7-8 km; many days overcast with cirrus appear clear in ceilometer imagery. The hour labels on the ceilometer imagery are offset by one hour from the true time: increase by 1 hour